

AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.



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AMSAT Board Meeting Summary

The AMSAT Board of Directors met over the weekend of Dec. 3, 4 and 5. The decisions rendered by AMSAT's top policy organ will affect AMSAT direction for years to come. Major highlights: new organizational structure emerging with several new officer billets identified; new dues structure approved effective 1 Apr. 83; *Orbit* magazine will continue in publication. Here are the details.

The Board of Directors gathered informally on Friday evening, 3 Dec., to discuss prospective agenda items and to elicit initial positions on issues that would be discussed later. This informal gathering, as well as the formal session on Saturday and Sunday, were held at the Goddard Space Flight Center, Greenbelt, Maryland. This is a NASA facility and Dr. Thomas A. Clark, W3IWI, AMSAT President and a NASA employee, hosted the weekend meeting.

On Saturday morning Chairman of the Board John Browning, W6SP, called the meeting to order. Present were all seven Directors including JA1ANG, G3IOR, VE2VQ, W3IWI, W3GEY, K1HTV and W6SP. Other attendees throughout the session were K8OCL, KD2S, W4PUJ, KA4JFO, W1HDX, KA9Q, KO5I, W1XT, W6XN (alternate Director), WA2LQQ, W2FPY, Martha, W2RS, W3XO, W0RPK and KA2PFD.

The first order of business was reading and adoption of the minutes of the last BoD meeting. KA9Q was named secretary to the Board. The Board then took up the question of AMSAT's connection with AFCEA, the Armed Forces Communications and Electronics Association. W3IWI explained that the involvement was limited to accepting a free booth at the Washington, D.C. convention in a manner similar to other public service organizations. W6SP pointed out that AFCEA comprises about 1/3 hams and the exposure is an excellent opportunity to develop contacts which could be very helpful in obtaining rare launch opportunities. G3IOR and W6SP agreed to co-author an article for *ASR* clarifying the AFCEA relation and underscoring AMSAT's neutral political posture in the U.S. and elsewhere.

The discussion moved next to the need to involve new personnel in the decision and management processes in AMSAT. Much thought was given to the "hows" and



Photographs taken at the recent AMSAT Board of Directors meeting held near Washington, D.C. Above, Tom Clark, W3IWI, addresses the directors. Clockwise around the table beginning at the near left are K1HTV, VE2VQ, W3GEY, KA4JFO, W6SP, W2FPY, W2RS, (W3IWI), W3XO, Martha, W1XT and KO5I. Below are (from the left) W6SP, W2RS, KD2S, W2FPY, Martha, W1XT, KO5I, VE2VQ, W6XN, K1HTV and W3GEY (foreground). Photos by WA2LQQ.



"whys" individuals become leaders within AMSAT and in particular how to promote participation by motivated, talented new individuals. The oft-discussed "Centers of Excellence" concept was elaborated again.

In a discussion on member services, it was decided that management of member services should be recognized and staffed separately from the functional engineering activities. Proposals for new structure within the engineering and operations directorates were presented.

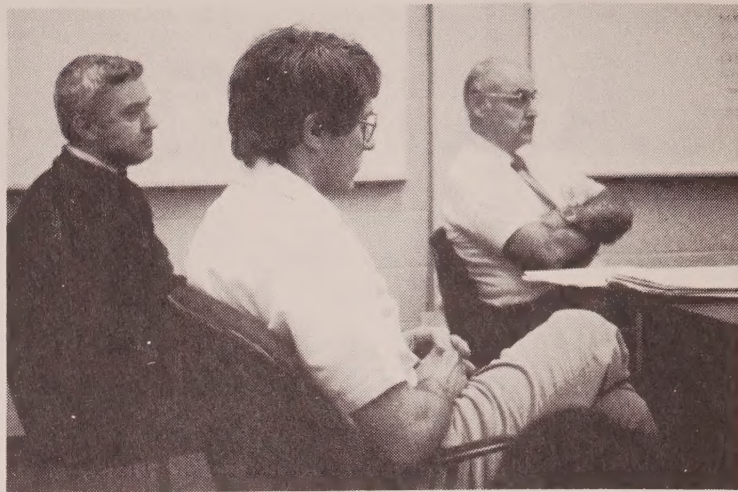
A discussion of W2RS's financial report followed. The Board allowed that the President be authorized to effect changes in the profile of the investment portfolio with the concurrence of the Chairman of the Management and Finance Committee (W2RS). It was stated that about \$70,000 was expended annually on member services including salaries (Martha), office rental, utilities, *Orbit* magazine (\$6,000 to \$7,000 per issue) etc. The 2,000 annual members at \$16/member generates \$32,000; the interest on Life Member Reserves yields \$8,000; the deficit is thus about \$30,000 per year for member services. Tom suggested that about 25% of office time should be charged to project expenses rather than member services.

Many technical projects were discussed including Phase IIIB (only spin balance test remains; Mode L transponder intermod products reduced now to -35 dB); Phase IIIC (proposal submitted to USAF for DSCS 3 launch in mid-1984); PACSAT (possible university liaison; several launch opportunities; much interest in affiliated AMSAT organizations; prospects of self-funded activity); SYNCART (no viable launch opportunities in sight; IF, CPU and DC/DC xvrtrs done in AMSAT Canada; rcvr and xmtr on-going in Project OSCAR's California group; VE2VQ to give paper at conference in Ottawa in June 83); Shuttle, STS-9 (joint ARRL/AMSAT proposal submitted; AMSAT to be technical advisor with ARRL in lead role for liaison with NASA; risk/benefit ratios discussed with emphasis on "high visibility" project framework); other miscellaneous projects were discussed.

Future funding levels were then discussed followed by a discussion of various office expenses including a proposed computer for processing membership records/activities.

The Board then approved a dues increase as follows: Effective 1 April 83 the annual dues will be \$24 (U.S., Canada and Mexico), \$26 elsewhere. Life membership will be 25 times the annual rate. The Board allowed application by senior citizens (on fixed/limited incomes) and students for a nominal 25% discount.

In discussing publications the Board heard that ASR is a no-cost, self-funding enterprise now endorsed by ARRL. *Orbit* magazine has, since its inception, failed to pay for itself as planned. WA2LQQ explained the root of the problem as being inadequate readership levels. The *Orbit* concept was based (3 years ago) on having the magazine generate sufficient advertising revenues to offset fully the cost of publication so that no monies would need flow from the treasury to the magazine. However, since the expected influx of new members attending the launch of Phase IIIA didn't happen, the cost per-reader-



KA4JFO, W3GEY and W6SP at AMSAT's Board Meeting.

reached to a potential advertiser has been much higher than comparable magazines (e.g. *QST*, *73*, *CQ*, *HR*, etc.). Without advertising revenues, AMSAT's choice has been to either make up the difference from the treasury or scrap the magazine until membership levels improve. The latter option would present an improved cost picture to the prospective advertiser. The Board decided that *Orbit* should continue through without interruption despite the additional costs involved because of the keen member interest in the magazine despite its schedule/production delays. Six issues were budgeted for 1983. The Board then heard that the difficulties in maintaining the 1982 schedule were largely attributable to overload of one or two key individuals. WA2LQQ then explained that there were three new editors coming on-line early next year to help relieve the tremendous workload. N1DM, W4OWA and KB2M will be "in training" over the next few months with N1DM assuming the Editor's chair by *Orbit* #15 scheduled for mid-83, explained WA2LQQ.

The Board then turned to the election of officers, the establishment of new offices and the ratification of appointments.

Reelected W6SP Chairman

Elected KA9Q Secretary to the Board

Reelected W3IWI President

Reelected WA2LQQ Executive Vice President

Elected K8OCL Senior Vice President (a new position)

Reelected W3GEY Vice President/Engineering

Reelected K1HTV Vice President/Operations

Reelected K9LF Vice President/Special Projects

Elected KO5I Assistant Vice President/Ops for Spacecraft Operations (new position)

Elected W0RPK Assistant Vice President/Ops for User Services (new position)

Elected W2FPY Assistant Vice President/Eng for Research & Development (new position)

Elected KD2S Assistant Vice President/Eng for Spacecraft Engineering (new position)

Elected KA9Q Assistant Vice President/Eng for Systems Analysis (new position)

Reelected K4YV Treasurer

Ratified KD2S PACSAT Project Manager, W2RS Chairman, Management/Finance Committee, W1HDX Manager of Ground Station Development.

A statement for the record was entered by W3GEY stating that the Board's rationale for instituting the new offices was to facilitate the transition of responsibility to new hands in an orderly manner. Jan regretted the appearance of bureaucracy that might result from the creation of the new slots. (W3IWI, W3GEY and K1HTV indicated their desired to "retire" in the next several months.)

The Board declined to act to add two new chairs to the Board to bring the total number to 9.

Special recognition of the Board of Directors was extended to KA5EIM, W4OWA, KD6DG and the SRI team, W8GQW. K1HTV will communicate the Board's appreciation.

The meeting closed with a playing of an audio tape recording of greetings from AMSAT UK Secretary G3AAJ. The meeting was adjourned at 16:15 Sunday.

Price Reduction

Thanks to the help of G3YJO, G3AAJ and G3IOR, the price of the IERE journal "Radio and Electronic Engineer" for August/September (containing the UO-9 papers) has been reduced. The new price is \$10 postpaid (mailed library rate) instead of the previously announced \$15. The old price was based on including shipment from England, but since G3IOR hand-carried several dozen copies when traveling to the U.S. in connection with the Board meeting, the transportation costs were reduced considerably. Thanks to G3's YJO, AAJ, IOR!

Short Bursts

•ISKRA-3 has been on—but it's still in trouble; it's got an oscillating 5 volt regulator, a blown transistor and it's very hot. Battery voltages are low. With 6 or 7 weeks left in its short life, not much hope is held out for a major contribution from RK-03. Cosmonauts-launchers Lebedev and Berezevoy returned to earth after a record 211 days in space.

•UoSAT boom deployment began the week of 13 Dec. 82; the tricky maneuvers to orient the spacecraft were complete and comprised a major scientific/engineering accomplishment since they were done only using the magnetorquers (and the wits of G3YJO et al).

•Look for UA3CR from South Georgia Island as 4K1G. Leonid will be operating the RS birds from the South Pole expedition; he traveled on ship operating as EK3CR.

•TU2IE will be active soon thanks to "tools of the trade" donation by G3IOR.

•KB2M joins *Orbit* staff with other new editors N1DM and W4OWA heralding the formation of a new "team" approach to *Orbit* production.

•PA0DLO on RK-03: 250 character codestore; "K" channel indicator codestore load, "O" is telemetry test level, "N" group gives temperature, "R" is main group; when main group prefaced by "I", command uplink in progress.

•Reminder—ISKRA frequencies: 21.230 - 21.270 up, 29.580 - 29.620 down.

•A new "Satellite Basics" net is in the "talking and thinking" stage. Many requests to provide introductory-level material in an accessible format/frequency have been heard. Possible new net will develop on 75 meters (3900 - 4000 kHz) or 40 meters to service the needs of newcomers. Several existing nets will be moving to Phase IIIB next summer, so other hf nets are now being looked at as "breeding grounds." Send your suggestions for time/frequency and format/content to:

AMSAT Net Manager W8GQW
1617 West McKaig Road
Troy, OH 45373

(See net listing in this issue)

•A recent *Westlink Report* details recent packet radio tests from Netherlands to California. The 6 Nov. 82 tests were an expansion of a transcontinental (air-mobile to ground-mobile) conducted a year and a half earlier. Project OSCAR's KN6W helped formulate and execute the tests.

•The Annual Report will be sent to all members shortly. The handsome presentation was in production at press time.

Clarification

Requests for orbital data should *not* be made to NASA's public affairs office. Instead, they should be sent to:

NASA
Goddard Space Flight Center
Code 512
Greenbelt, MD 20771

Be sure to include adequate satellite identification information, e.g. catalog or object number. Thanks W3IWI.

Satellite DX Record

In the September 1982 edition of *Amateur Radio* I included a reprint of a report from *AMSAT Satellite Report* #37 which suggested that a recent QSO via RS-8 between VK4TL and WH6AMX was an alltime satellite DX record and a first between VK and WH6.

John VK4TL has now written to me to clarify the report. John's first contact with the North Pacific Area was on 27th January 1978 with WA8VDJ/KH6 in Kure through OSCAR 7 Mode B; this was followed on 12th March 1978 by a QSO with KH6OS in Honolulu.

A QSO was also made with KH6JHR in Honolulu on 30th January but no QSL card was received; John was 'heard only' by KH6OS on Mode A on 23rd February 1978 but no QSO resulted. My calculations indicate that the distance from John's QTH in Cairns to Kure is 6344 km and to Honolulu 7470 km. John has also worked UA0LBU in Vladivostok on Mode B, a distance of 6820 km and he lists other countries worked by satellite: ZL2, JA, JR6 (Okinawa), VS6, P29, KC6, HL9, DU6, KH6, KH6 (Kure), KG6, 9M2, RA0, H44, YB0, FK8.

It is now clear that the contact between VK4TL and WH6AMK on 3rd July 1982 was neither a first nor a

record but nevertheless it was most creditable and both operators deserve our congratulations.

Unfortunately stations in VK3 are precluded by distance from working some of the above mentioned DX but as a consolation we do have the opportunity to work all ZL call areas as well as the elusive Antarctic stations.

I have also worked into ZK1 and for the record my personal best DX is JR6AE (Okinawa) at 7334 km and VS6HI at 7413 km. —VK3ZBB

Affiliated AMSAT Nets

Net Name	Day/Time UTC	Freq.	Remarks
H.F. Nets			
AMSAT Argentina	Sunday	3737	2100 Local Time
AMSAT Argentina	Sunday	14277	2200 Local Time
AMSAT Asia/Pacific	Sunday 1100	14305	
AMSAT Austria	Saturday 0900	7070	
AMSAT Australian	Sunday 1000	3680	During Winter
AMSAT Australian	Sunday 1000	7064	During Summer
AMSAT Canada			To be determined
AMSAT East Coast, U.S.	Wednesday 0200	3850	2100 EST Tuesday
AMSAT Espanol			Being rescheduled
AMSAT European	Saturday 1000	14280	
AMSAT International	Sunday 1800	21280	
AMSAT International	Sunday 1900	14282	
AMSAT Mid-America	Wednesday 0300	3850	2100 CST Tuesday
New Zealand V.U.S.			Being rescheduled
AMSAT South Africa	Sunday 0900	7080	LSB
AMSAT South Africa	Sunday 0900	14280	
AMSAT South Pacific	Saturday 2200	28878	
SESAT South East, U.S.	Sunday 1300	7280	
AMSAT U.K.	Sunday	3780	1015 Local Time
AMSAT U.K.	Mon. & Wed.	3780	1900 Local Time
AMSAT West Coast, U.S.	Wednesday 0400	3850	2000 PST Tuesday
VHF Nets			
AMSAT Buenos Aires	Sunday	145.700	FM
AMSAT Dallas/Ft. Worth	Wednesday	146.610	FM 2000 Local Time
AMSAT Goddard	Wednesday 0200	146.835	2100 EST Tuesday
AMSAT London	Sunday	144.280	1930 Local Time
AMSAT Los Angeles	MTWThF	144.144	0730 - 0830 Local Time
AMSAT South Africa	Sunday 0900	145.650	FM
AMSAT South Africa	Sunday 0900	145.725	FM

QSL Bureau Instructions

1. The AMSAT QSL Bureau serves the users of all amateur radio satellites with a complete QSL Bureau for amateur radio satellite contacts (QSL's for QSO's other than satellite QSO's will be returned).
2. Stations wanting to use the bureau need only send between three and six #10 SASE's with your call in the upper left hand corner. DX stations: include enough IRC's for each envelope of file!
3. To send cards through the bureau, arrange your cards in alphabetical order by call sign. Stateside cards are free. However, there is a charge of 5¢ per card for all stations outside U.S. postal districts.
4. Always keep the bureau informed of any changes in your address or call sign. If you have worked other stations with more than one call sign, you should send envelopes for both calls.
5. Mailings from the bureau will be at the end of each month. All envelopes with ANY cards will be sent at that time.

6. QSL cards that are received at the bureau when no envelopes are on file will be held and the bureau will make an attempt to notify the user that he has cards on file. If envelopes are not sent within a period of 6 months the cards will be discarded.

7. Questions about the bureau should be sent with an SASE to:

AMSAT QSL Bureau
1850 Lisle Avenue
Obetz, OH 43207

Phase III Ranging Test

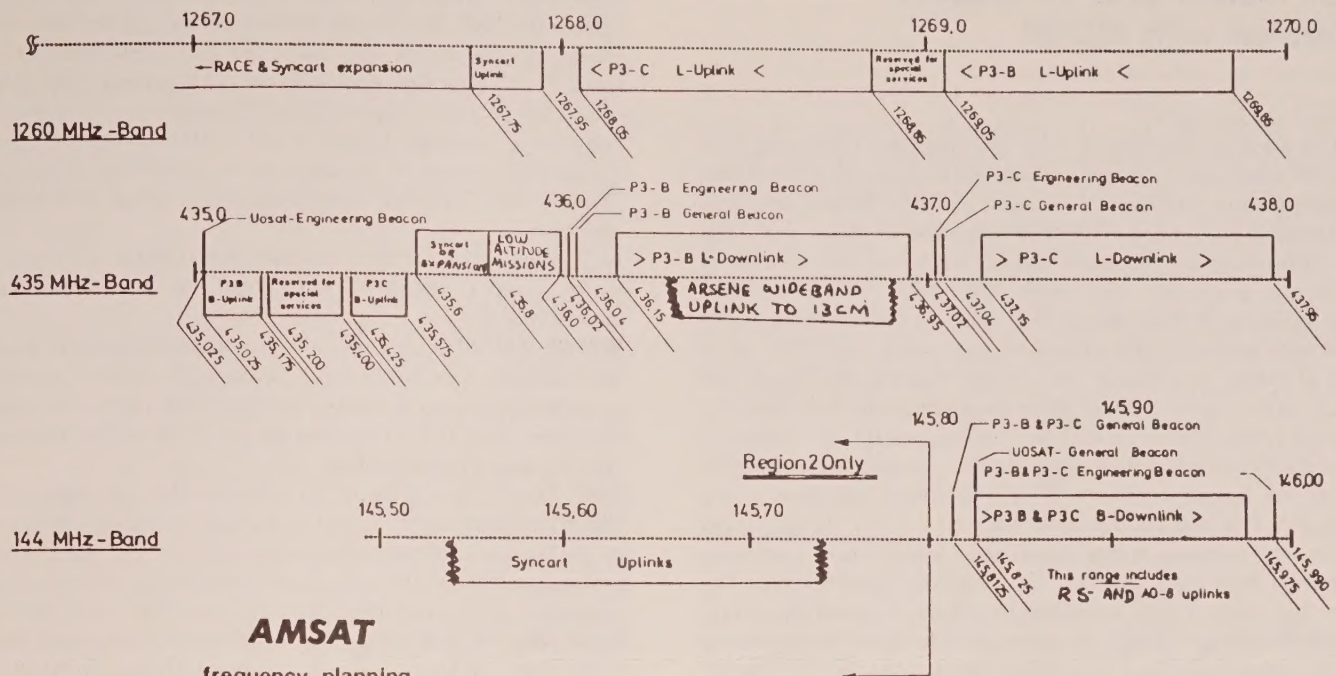
The complete system for determining Phase IIIB orbital parameters from our own range measurements has been tested recently by practicing on the OSCAR 8 spacecraft. These tests are being conducted by operating the Phase III command modem through AO8's Mode J transponder. The ranging signals are transmitted and received at W1HDX's QTH in Massachusetts and then processed in the ground command computer to yield a range to the satellite in km at intervals of 1 second during the pass. The disk file containing the range data obtained is then sent via the electronic mail system to KA9Q in New Jersey where his orbit determination software produces the orbital elements. Initial results have been very encouraging; most elements are coming within a degree of NASA bulletin values. The exercise has turned up some bugs, of course. One such bug insisted that the W1HDX QTH was 220 km above sea level! The bugs are rapidly being chased out, however, and the system is improving almost daily in preparation for the real mission.

Range measurements are performed with the Phase III command-telemetry system and an S-100 bus computer using the AMSAT IPS language. A stream of characters in ASCII is transmitted on a convenient frequency within the AO8 transponder passband. Using special software developed by WØPN for range measurement, a ranging "message" is inserted in the outgoing data stream and a timer is started coincident with the leading edge of the leading bit of the first character.

The returned data stream from the satellite is demodulated and examined for the range message. Once that is received the timer is stopped. The number of 500 ns computer clock pulses which have been counted by this timer between transmission and reception of the range message is then processed by the computer to account for various constant factors and yields a range to the satellite. A typical 2 way travel delay is 13.3 ms representing a range of 2000 km at 3.33 µs/km. The accuracy of this technique is limited mainly by time delays in the circuitry which are part of the measured time but not perfectly constant. These contribute an uncertainty in the measured time delay in the area of 50 to 100 µs or 15 to 30 km in range.

A typical block of data is shown in figure 1. The UTC day number and time appear for each range measure-

(Continued on the last page)



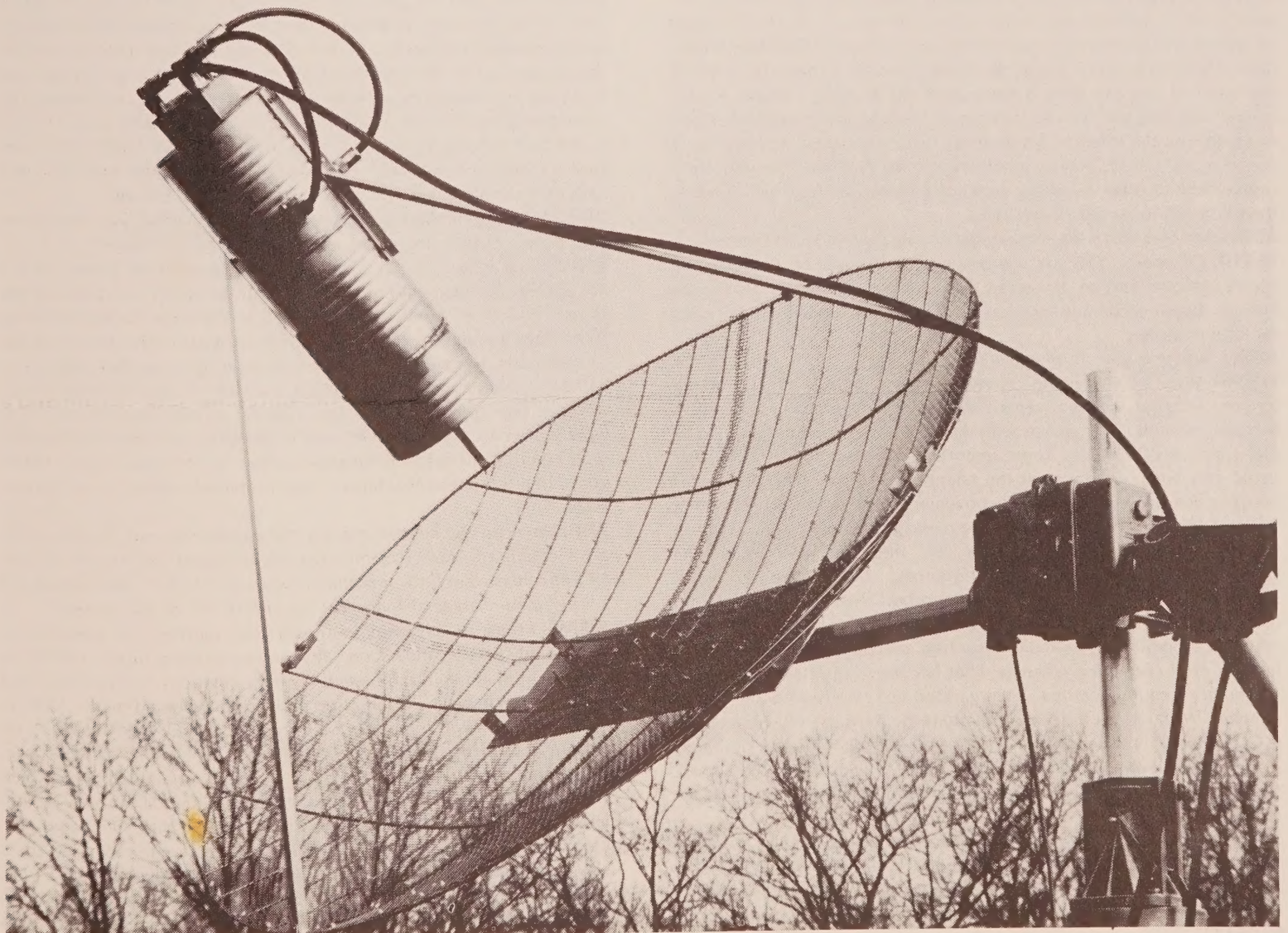
AMSAT

frequency planning
for projects 1981-1986

REVISED 4 OCT 82 IN PARIS
TO ACCOMMODATE LOW ALTITUDE
AND ARSENE MISSION PLANS,
AND TO AFFORD 70 CM EXPANSION
ROOM FOR NEW MISSIONS.
T.CLARK-W3IWI

⚡ DENOTES DETAILED
FREQUENCIES TO
BE DETERMINED. ⚡

AMSAT DEUTSCHLAND e.V.		Telefon 0441/778-1111 355 Marburg - 1 Holderstrauch 10
Zeichnung Nr. 3073 A		
EM	OP	DB
Datum 22.8.81		
Multitab		
geändert am 72		
frequency planning for projects 1981-1986		



The W1HDX Mode L dish.

Packet Radio and PACSAT: An interview with W3IWI

ASR: *What is packet radio?*

W3IWI: The word packet derives from the concept of breaking long messages into small groups called packets. Packets are easier to handle through transmission systems and are more reliable. Packet radio can best be likened to high-speed RTTY, but with a few improvements. The important differences are the speed, the accuracy and the inclusion of error correcting characters and some other tricks which facilitate automatic handling of these digital messages. So packet radio shares much with prior amateur radio techniques such as cw and RTTY. Its an outgrowth of these. So although the concept might seem foreign and forbidding, it really is quite close to some things amateurs have been doing for quite a while. The fact is that now they can do it faster, more accurately and with less effort than ever before so amateurs can now concentrate on the fun of communicating and spend less time in the mechanics of it. It is important to note that many, many digital packet systems are now working in the commercial and military segments. These segments have gone "packet" for some darn good reasons. The same ones that make it very attractive to amateurs: speed, accuracy, ease of transmission and a host of more subtle reasons. An interesting overview of packet networks was given in the October 1981 QST, page 28, in an article by K8MMO and W4RI. This should provide you with the next level of detail answering your question.

ASR: *Tom, what is the PACSAT Project we've heard about in recent months?*

W3IWI: PACSAT is a concept for a future, low polar orbiting satellite especially designed for digital communications.

ASR: *What makes PACSAT different from other prior OSCARS?*

W3IWI: There are a few important differences. But first, let us review the similarities. PACSAT will be a communication satellite just like most of the previous OSCARS. As with the recent OSCARS it will be in a polar orbit; its altitude will be just about the same as AO-8. The main difference will be that communications will be digital. The other important difference is that it has a "store and forward" capability so that if you want to you can store a message in the satellite memory for someone who may not even be in range at the time. Later, when that person calls into the satellite, his message from you can be accessed as if you were right there. This non-real time communication is an important supplement to other real-time communications amateurs will have at their disposal including Phase IIIB.

ASR: *Does that mean that digital and analog satellites can coexist?*

W3IWI: Of course. SSB and cw probably will never be displaced by digital communications. However, there are some important reasons to look at digital techniques now as an adjunct to AMSAT's traditional satellite programs.

ASR: *Could you give us an example?*

W3IWI: Well we've already mentioned one, that is the store-and-forward concept which is remarkably effective for communications between individuals or groups with different time schedules. For example, suppose G3IOR had some important bulletins for JA1ANG. Pat could very well call Harry on the telephone but the time differences between the two would surely inconvenience one or the other. With a PACSAT bird to temporarily store the message until the satellite was in sight of Japan, Harry could call for "his" messages from around the world. The problem of time differences, sleep schedules, work schedules is overcome. Another very important reason to look at digital techniques is the vast improvement in accuracy attainable even in marginal conditions. Virtually error-free reception is possible with modern error-correcting schemes. That becomes important in terms of emergency communications when garbled text can have grave consequences. With packet radio transmissions the message, when received, is GUARANTEED to be perfect. So we see that PACSAT is quit similar to a computer bulletin board like that run by N5AHD except with PACSAT the user would employ a radio link instead of using long distance telephone calls!

ASR: *Packet radio hardware still seems to be unavailable to the great majority of amateurs. How do you reconcile the equipment vacuum with a suggestion that the PACSAT would be popular? It would seem that only an elite few with access to special equipment would have access to PACSAT.*

W3IWI: The digital hardware available now IS minimal. The Vancouver Area Digital Group have made a few hundred of their Terminal Node Controller (TNC) boards available and they can be found on the air in areas like Washington, D.C., San Francisco, New Jersey, Ottawa and so forth. The Tucson Area Packet Radio (TAPR) group is about to distribute nearly 200 of a second generation TNC which costs less than \$250 wired and tested. I anticipate that we will see these activities growing in the future and foresee no problem in availability of suitable hardware. Perhaps AMSAT will even become a source of suitable hardware for its members.

ASR: *Why do you believe AMSAT should become involved in packet radio? Doesn't AMSAT's charter call for more traditional satellite development?*

W3IWI: AMSAT's charter calls for advancement of amateur radio technologies...it says so in our bylaws...In this sense if we were not alert to technology opportunities we would be derelict in our responsibility. Moreover, if we fail to innovate, we will have lost our primary asset: access to launch opportunities.

ASR: *Are you saying that it is innovation that gets rides on launchers?*

W3IWI: Not precisely...but it has a great deal to do with the perception of the launch authority as to our credibility. And our credibility in the professional scientific and engineering circles depends critically and ultimately on our collective ability to convince these officials that we know what we are doing, that what we are proposing has technical merit, that it in some way can advance the state of the art and that it will bring some good to mankind. It's as simple as that.

Therefore, it is my conviction that we must innovate; it is our primary reason for organizational existence.

ASR: *But where does the user come in? How can he keep pace if you're updating the "machines" one right after the other?*

W3IWI: We are not talking in terms of changes occurring overnight. Rather we are talking about long-term, evolutionary changes, enhancements to our hobby. I emphasize that the PACSAT concept is not meant to displace our present user community or herd them into a packet radio "box" if they don't care to go. No! What we are saying here is that there are remarkable new, exciting avenues of technology to be explored, harnessed and then brought into the amateur satellite hobby. But not at the expense of the traditional activities. To the contrary, we are addressing a NEW branch of a growing tree. Indeed the salient fact here is that AMSAT needs to grow...and to grow in traditional directions as well as some attractive new areas. The PACSAT concept is merely a new branch that will help AMSAT grow into new areas with new people eager and willing to help bear the load.

ASR: *Do you think there is really a "market" for PACSAT out there or are you merely groping about looking for some new challenge?*

W3IWI: The answer to that question is easy...and yet not so easy. First, I am absolutely convinced of a huge, receptive group out there anxious to get on with it. And yes, we do need a challenge for our technical folks. They are in this "game" not as operators or certificate hunters but as dedicated designers and builders. Without grist for their mills there will be no construction, no satellites, no AMSAT, period! Additionally, we have seen a massive increase in digital technology and interest to work in that area. The present team of designers, planners and builders have been sought out by the digital community for help in meeting their goals. In return these new talents have promised support for all our projects.

ASR: *How can you be certain about the appetite for packet radio activity? A couple of AMSAT members strongly suggest the majority of AMSAT members want little or nothing to do with PACSAT. How would you answer their charges of force feeding of PACSAT to the masses?*

W3IWI: I think the best way to answer your question is to point first to some hard facts to underscore why we see a strong future AMSAT involvement in amateur radio digital communications. I would point first to an extensive survey of amateur radio commissioned by the ARRL in 1980. The results of the survey are summarized in QST, March, 1981. Of special note is the following.

First, there are more than five times as many amateurs into personal computing as were involved in amateur satellites. That's very significant! That number has grown since then too. Next, there were one and a half times as many amateurs active in digital communications as there were active in amateur satellites. We strongly suspect that number has grown such that the data communicators now outnumber the satellite communicators by even a wider margin today. But that's history. What about the future? Again we refer to the data in QST. What do we find in

terms of growth potential? Well for one thing we find that the greatest growth area will be in amateur satellites with one of every five amateurs in the U.S. and Canada either on the birds or planning to be active. The next one is a shock, however. More than one out of FOUR will be active with personal computers. Moreover, one of seven will be active in digital communications. That tells AMSAT something about where the interest lies. It also points to a significant growth opportunity for AMSAT. And it is growth that will afford us the resources to implement our ambitious plans. As we have seen, personal computing will be more popular than amateur satellites. We'd like to combine the interests for those who have a dual interest. In so doing we will benefit all within AMSAT with our diverse views, interests and preferences.

ASR: *What about AMSAT individuals? Have you surveyed them to determine what their feelings are?*

W3IWI: While we haven't conducted a formal survey, we certainly have been soliciting inputs from the members. Since the possibility of a PACSAT mission emerged last summer I have talked in person and by phone with a large number of people across the country and around the world. I have found it necessary to begin these discussions by describing the concept and the anticipated capabilities. I have found essentially universal acceptance of the concept in these discussions. One of those I polled, W0CY, took the question to the Tuesday evening 75 meter Mid-American Net. They devoted the entire evening to a discussion on PACSAT. Jim reported to me that throughout the midwest there was strong support for the concept. Similarly, at the Annual Meeting in October we demonstrated packet radio action and then described PACSAT as a concept. The only reservations expressed were in the nature of, "are we spreading ourselves too thin?" I took these expressions of support to heart in pressing to get a better definition of PACSAT. It is significant that every AMSAT Director and Officer, and a number of key individuals well-connected to the members, are unanimously in favor of proceeding with the PACSAT concept.

ASR: *Aren't they more or less obliged to "go along" with the idea?*

W3IWI: At the recent Board meeting an interesting thing happened. A few of the attendees arrived as skeptics. Once they learned what PACSAT was about and what the long range benefits were, they universally praised the concept...became PACSAT converts...strong supporters.

ASR: *If this is so, then why is there an element of dissent from the members?*

W3IWI: Mainly because we haven't done the best possible job of explaining to the members what PACSAT is about. This situation has really come about because of the speed with which the PACSAT concept is developing. Much of the conceptual work and the contractual relations haven't been worked out yet. This puts us in a very delicate situation of trying to work out some very sensitive negotiations with the entire world eavesdropping on every word. It would be a shame to lose a prospective string of launch opportunities because of our having to negotiate sensitive matters in the open. I believe the PACSAT concept will be warmly embraced by the overwhelming majority when the facts are known. I think the apprehension folks now feel is based on the perception that somehow PACSAT is going to "put them out of business" as far as what they most like to do on OSCARs. As I see it, PACSAT is a project that will augment Phase III and more traditional means of communications rather than displacing them.

ASR: *But with the great recent commotion about AMSAT solvency, isn't PACSAT bound to drain the coffers even further? Given a choice between funding Phase III and funding PACSAT which would you support?*

W3IWI: First let me address the solvency question. We are faced with two problems at this time. With the current size of the membership, the members' dues barely cover the cost of services. Inflation has been whittling away at the "barely" day-by-day. In the past, AMSAT's dues structure has been based on a calendar year basis for all regular (that is non Life) members, and we are now at the end of the year. The treasury is tight because we haven't yet received the torrent of renewals. When AMSAT was smaller, we instituted Life Membership as a convenience to the members and as a way to raise cash to fund Phase IIIA. The dues contributed by our Life Members have constituted a reserve to buffer crisis and the interest derived from these reserves was supposed to pay the Life Member's dues.

After we lost Phase IIIA, W3GEY and I drew up a recovery budget of \$270,000 to make Phase IIIB and C happen. We have stuck to that budget but unfortunately we have raised only a bit over \$200,000 in the interim. Where did the balance come from? It came from the Life Member reserves. In short, we have mortgaged much of AMSAT's future

on the success of Phase IIIB. We anticipate that come April, we will see a large influx of new members. But until then our finances are tight. Therefore don't think of us as insolvent and about to file chapter 11! Now returning to the original question, I don't feel PACSAT will cause a significant dent in our financial situation. You see, the way the situation is now developing, PACSAT is drawing so much enthusiasm from new contributors, it appears quite likely that PACSAT will be self-funding. That means that it will not compete for funds, for the most part, with Phase III or other key AMSAT projects. We have a substantial number of irons in the fire. It's just good sense to diversify. Our existence is a lot more fragile than most folks would easily perceive. But it's more than the bank balance that makes for a solid organization. It's flexibility and diversity of interest that makes AMSAT strong just as the diversity of interests and talents of our members is a vital component of our strength. So PACSAT adds important breadth and strength to AMSAT without sapping our resources in any meaningful way. And here's the key point that I wish to drive home. The new talents drawn in by the attractive PACSAT project will contribute meaningful dollars and hours to our resources. That will help insure our long-term health. In other words, not only will PACSAT not be a major drain on our coffers, it will likely be a major fundraising focus for thousands of new amateurs. Everywhere I've spoken about PACSAT I've heard enthusiasm. What we really need now is for the REAL word about the PACSAT concept to get out. Then at least if a few folks want something to criticize, they'll have a factual basis from which to offer constructive criticism.

ASR: *You say that PACSAT could be self-funding? How would that work?*

W3IWI: We have several avenues of approaches open to us that would allow the design, construction, test and launch of PACSAT. I can't go into detail here because of the sensitive stage at which negotiations stand, but I can say this. We are working very hard to have the PACSAT concept picked up by a consortium of universities. Part of the funding would come from various AMSAT groups. The major effort would center in the electrical engineering department of one or more universities. Funding would come from grants and staffing would be covered by faculty and student fellowships and the like. We have already had some expressions of interest from external groups who are interested in applying our low-cost technology to non-amateur problems. We can foresee a possible scenario in which a satellite carries two virtually identical transponders OF AMSAT's DESIGN. One would be our PACSAT on Amateur frequencies and the other would be designed to explore non-amateur use of the same technology.

ASR: *What about the launch opportunity? Have you got one and if so, why not use it for another OSCAR 8 or the like?*

W3IWI: We are diligently working on the launch opportunity now. We believe there is a reasonably good chance that we can obtain a ride with an early Space Services Incorporated launch in 1984. Martin Sweeting, G3YJO, is talking with SSI about the launch opportunities now. We have also identified a possible NASA launch into similar orbit in about the same time frame. Beginning in 1985 the Shuttle may provide us with polar, OSCAR-8-like orbit opportunities. As for using these types of opportunities for another linear transponder, OSCAR-8-type satellite, that is unlikely for several reasons. First of all, with at least one and possibly two Phase III birds up and running, the potential user community for an OSCAR 8-type satellite will diminish radically. For those still interested, we have fairly good confidence that a long stream of RS and ISKRA birds will be available for years to come. In essence, however, once the amateur community gets to know Phase III and has the prospect of Phase IV geosynchronous satellites in view, we see very little utility for these low earth orbits except for some special tasks. PACSAT is one of those special tasks that is ideal for that orbit since every station on earth has access for a few passes every day. Since the satellite is closer than Phase III, the users' RF requirements are minimized. Since the passes for any one station are brief and since a small part of the earth is covered at any one time, the user QRM problems, which are critical for digital communications, are minimized. Just imagine what the RS robot would have sounded like if it had been in Phase III's high altitude orbit! In short, it seems to us that packet radio is a perfect user for any low-altitude satellite launch opportunities we can promote. And that's why we're advocating PACSAT.

ASR: *Why is it that you believe you understand what is needed whereas you say your critics miss the point?*

W3IWI: Sitting in the President's chair gives one a perspective that is not available elsewhere. My job as President requires me to be aware

and respond to both the short term and long term goals of our organization. To do this...to make critical judgments...I must rely on my key staff advisors, the officers, directors and project managers. And I must in the end rely on my best judgment and expertise. That IS after all what leadership is about. Rendering one's best judgment given imperfect information at an inopportune time under the worst of possible circumstances! I frankly believe I could've done worse. Sure I've made some blunders...but I sure don't think PACSAT is one of them! To the contrary, from where I stand PACSAT is an exciting new concept...the right idea at just about the right time...to benefit AMSAT enormously if...and I emphasize IF...we know how to capitalize on it. I am encouraged to note that the entire directors and officer staff agrees with me on this one. Can twenty million Frenchmen...or twenty AMSAT veterans be wrong?!

ASR: How much money has been spent out of AMSAT's coffers so far on PACSAT?

W3IWI: About one thousand dollars in seed money has been expended to date. This has been used to cover travel and telephone calls so that certain key individuals could get together to discuss the concepts and to see if a workable project could be devised. The Board of Directors has approved a budget to continue these definition activities for the next few months at a level not to exceed \$4000.

ASR: Isn't that rather risky given the state of AMSAT's reserves?

W3IWI: Let's set some numbers out so we can see what we are talking about. AMSAT's budget for Phase III was \$270,000. The PACSAT seed money is less than one per cent of that. Sure a thousand bucks is a lot of cash. But its less dramatic when put against the fact that we've already spent more than a quarter million bucks on Phase IIIB and C. Furthermore, although we have been rattling the tambourine for more donations now for several weeks, this is something we are forced to do by the very nature of our being. That is, as a non-profit corporation we must constantly point out our needs in order to raise funds. We have never been and will never be well-off as far as reserves. It's just the nature of the beast. Also, we tend to be conservative in fiscal matters and try to portray our needs in terms that will motivate folks to chip in where needed. This year our revenues were less than expected, mainly because of the Phase IIIB launch delays, and so we are beating the tambourines a little harder than usual. This doesn't mean we're about to fold. Not at all. We do have adequate reserves to cover most contingencies until next year. But we certainly want to encourage folks to renew and donate so that we can be as fiscally sound as ever.

ASR: Could you summarize your sentiments on the subject of PACSAT?

W3IWI: To me and all the folks I've talked with directly, PACSAT is one of the most exciting, enthusiasm-building concepts to come along. It will draw thousands of new contributors into the AMSAT fold. This diversification will be important to AMSAT's future as we reach out to various groups and interests who want to follow our lead in amateur space activities. Each of the adjunct activities will tend to support and focus on our mainstream "business" of building the most advanced amateur communication satellites for our members to use and enjoy. And the very nature of these challenging new resources will insure AMSAT's longevity and fiscal health. And it will help re-establish Amateur Radio's position of prominence in advancing state-of-the-art communications techniques. Further, it has the possibility of promoting ties to certain non-amateur groups which can only strengthen our future position. Each of the projects in AMSAT will coexist and be mutually beneficial. The result will be a broad suite of space resources from which a member can choose his favorite be it traditional sideband or cw or more advanced techniques such as synthesized digital voice, digitized video and others. I recall a fanciful prospectus written by WA2LQQ and published in *Orbit* #1. The basis of the story was the use of the AMICON channel of Phase III. But the message that digital communications had arrived in the world of Amateur Radio was the main theme. I believe it. So do a lot of other people. AMSAT will be there among the leaders in taking digital techniques into space...our traditional innovation grounds!

Phase III Ranging Test (Continued from an earlier page)

ment ahead of the range itself. The disk file containing this data, about 200 to 300 acceptable points per AO8 pass is then transmitted by 1200 baud modem over the telephone to KA9Q in New Jersey for further processing to remove errors and reduction to orbital elements.

T 332/1310:13 2257 W1HDX..GCS	T 332/1310:15 2250 W1HDX..GCS
T 332/1310:21 2231 W1HDX..GCS	T 332/1310:23 2211 W1HDX..GCS
T 332/1311:48 1858 W1HDX..GCS	T 332/1311:49 1862 W1HDX..GCS
T 332/1311:49 1856 W1HDX..GCS	T 332/1311:53 1845 W1HDX..GCS
T 332/1311:54 1842 W1HDX..GCS	T 332/1311:55 1839 W1HDX..GCS
T 332/1311:56 1835 W1HDX..GCS	T 332/1311:56 1835 W1HDX..GCS
T 332/1312:01 1819 W1HDX..GCS	T 332/1312:02 1816 W1HDX..GCS
T 332/1312:02 1817 W1HDX..GCS	T 332/1312:20 1763 W1HDX..GCS

Figure 1

Once the data has been received at KA9Q's computer, it is reformatted and fed to a "differential correction" program. This program's job is to find the combination of orbital elements and station position and time errors which best predict the actual observations by a "least squares" criterion. The problem is much like tuning an antenna tuner; one must tune usually three knobs to minimize the swr and best match the antenna to the transmitter. The differential correction program tunes seven "knobs" (the Keplerian orbital elements), plus six "knobs" for each ranging station (errors in station position, clock, and distance measurements) in an attempt to best match predictions based on the unknown elements to all the observed data.

The program runs on a VAX-11/780 computer under the UNIX operating system and can accept hundreds of observations from one or many ground stations. While it takes longer to process more data points, the results are more accurate, particularly if the data points are collected by several stations over a relatively long period of time (several orbits). The algorithm used is a standard one used by NASA to determine orbital elements, although KA9Q wrote the code himself in the "C" language. It may take as much as 5 minutes of CPU time on the VAX to find the "best" fit to a given set of 500 data points, but a good approximation to the final result is usually obtained in the first few seconds. It would have been possible to write a faster program, but the approach used provides simplicity and flexibility instead of speed. For example, if accurate azimuth/elevation or doppler observations were available, the program could be easily modified to accept them.

It should be pointed out that this program has alternate uses to determining satellite orbits. Since it applies error factors to station position, it could be used to locate a ground station. Such techniques are used with the SARSAT (Search and Rescue) system which AMSAT first demonstrated with OSCAR 6 and 7.

Because of the large amount of "number crunching" done by this program, it will NOT run on small microcomputers, and there are no immediate plans to convert it to the ZX-81, for example. —W1HDX, KA9Q